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ABSTRACT

Paper produced in the past century is acidic and is becoming too brittle to use. Information that was stored in materials with this paper is becoming lost. Treating these materials is expensive. Libraries are now spending as much to treat and repair old materials as they are on new acquisitions. To decrease the financial need to maintain what libraries already have, materials should be produced on alkaline paper. Most of the research performed on this topic has concentrated on monographs. The need to publish serials on alkaline paper is just as great as it is for monographs. This study tested two issues from 1993 and two issues from 1988 of 546 titles for the pH level of the paper. An equal number of monographs were tested. Spearman rank order correlation coefficient was performed. This study discovered that serials are peer reviewed and published in the United States, Canada, and European countries are more likely to be printed on alkaline paper. Serials that are printed in 1993 are more likely to be printed on alkaline paper than serials printed five years earlier. (Author)

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The Use of Alkaline Paper in Serials Publications

A Master's Research Paper submitted to the
Kent State University School of Library and Information Science
in partial fulfillment of the requirements
for the degree Master of Library Science

by

Jane E. Slosser

May 1994

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ABSTRACT

Paper produced in the past century is acidic and becoming too brittle to use. Information that was stored in materials with this paper is becoming lost. Treating these materials is expensive. Libraries are now spending as much to treat and repair old materials as they are on new acquisitions, To decrease the financial need to maintain what libraries already have, materials should be produced on alkaline paper. Most of the research performed on this topic has concentrated on monographs. The need to publish serials on alkaline paper is just as great as it is for monographs. This study tested two issues from 1993 and two issues from 1988 of 546 titles for the pH level of the paper. An equal number of monographs were tested. Spearman rank order correlation coefficient was performed. This study discovered that serials that are peer reviewed and published in the United States, Canada, and European countries are more likely to be printed on alkaline paper. Serials that are printed in 1993 are more likely to be printed on alkaline paper than serials printed five years earlier.

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I. INTRODUCTION

The earliest examples of paper are still strong and flexible after thousands of years, and paper made as recently as twenty years ago is yellowed and brittle. Paper has been made from various materials, the most enduring of the old examples were made from rags. In the mid-nineteenth century, paper makers began using an alum/rosin sizing. This sizing allowed the inks to dry on the page more clearly. Unfortunately, what made the paper easier to use at the time is now what is destroying that same paper today. The alum/rosin sizing chemically changes to sulfuric acid. The long cellulose fibers from plant materials are what give paper its flexibility and strength; and the sulfuric acid slowly eats through the cellulose fibers. This process causes paper to become brittle.

The reason for the brittleness of paper was only recently discovered. It has taken quite some time for the publishing industry to understand and respond to the concerns that the library world has for acidic paper. To determine acidity, the pH scale is used. The pH scale is used in chemistry to determine the hydrogen-ion activity of a substance. The scale runs from zero to fourteen. If a substance rates less than seven, then it is considered acidic; a seven is neutral, and greater than seven is considered alkaline. Paper that is neutral or alkaline is considered permanent. There was a great deal of research performed on this topic in the late 1980s. Of

the studies that libraries have performed, primarily testing the paper of monographs, there have been very few that examine the paper quality in serials publications. There may be at least two reasons for the lack of study of paper quality in serials publications. One of the reasons may be that the same printers are being used for serials and monograph printing. If this were the case, then the studies would be redundant. The second reason may be that libraries frequently retain serial publications in a microformat. Therefore, if all libraries and archives retained all serials in a microformat, this would limit the need for paper permanence. However, most libraries still retain most of their serials in a bound format, so there is still the need for paper permanence. Recently, all university presses agreed to use only permanent paper.

Purpose of the Study

This study will examine how commercial publishers fare. Also, it will test to see if the serial publications that have the statement for paper permanence, are in fact alkaline. The objectives of this paper are:

* to determine if scholarly journals are more likely to be printed on permanent paper than non-scholarly journals;

* to determine if European and United States publications are more likely to be alkaline than publications from other countries;

* to determine if serials published in 1993 are more likely to be printed on alkaline paper than issues of the same serials published in 1988;

* to determine that serials with paper permanence statements, in compliance with American National Standards Institute, have a very low incidence of acidic paper;

* and to determine if serials are less likely to be alkaline than monographs.

Definition of Terms

Serials are defined using the Anglo-American Cataloging Rules second edition revised; publications that are issued in successive parts that carry a unique numeric and or chronological designation and that are intended to continue indefinitely. For the purposes of this paper, scholarly journals will be defined as serials that are peer reviewed.

II. REVIEW OF THE LITERATURE

The modern paper making industry used cotton rags as the basis of paper until the supply of rags available could not meet the demand for paper. The industry than moved to using wood pulp as the basis for making paper and began using an alum/rosin sizing so that the inks would not bleed across the page. Both Williams[1] and Brown[2] report on the discoveries by Kohler and Hall that the alum/rosin sizing results in sulfuric acid and been demonstrated to be responsible for rapid paper degradation. Williams[3] also reports on the discovery by Edwin Sutermeister, that paper with a calcium carbonate filling, which tests at a pH level of 8.9, will still retain full strength and flexibility even after twenty-five years. This same study by Sutermeister also determined that it was not the rags in early paper that allowed for its permanence, but rather that it was not acidic. Studies performed by Barrow and Van Koyen, also reported by Williams[4] finally asserted that good alkaline paper will last thousands of years and that acidic paper will become brittle in about fifty years.

In 1975, the Technical Association of the Pulp and Paper Industry held a symposium.[5] At that time, the most prominent type of paper making was a process called kraft. The symposium was a response by the

industry to examine options to the new environmental laws. One method was to continue to make paper using the kraft process and to modify the factories with emissions control to meet the standards. The other option, already in use at that time by a small number of paper makers was to begin making paper with a new process that used an alkaline, calcium carbonate. While the motive for the changes were environmental, they were also advantages to the library community. Williams[6] wrote that these new paper production techniques were "more economical to produce, cause[s] less erosion of the paper-making equipment, and give[s] cleaner effluent, or none." A paper by Nanis, Kalina,Merrill-Oldham, and Manns[7] confirms that changing from an acidic process to an alkaline process: reduces water consumption; follows environmental laws requirements; is cleaner; and is less corrosive to machinery, which reduces down time. This process also reduces energy consumption and reduces materials costs.

So why has the paper making industry not switched to alkaline production already? The reason is primarily due to factors of capitol outlay. As the paper-makers machinery needs to be replaced they will probably see an increased advantage to replace current systems with alkaline processes. The second factor is that there seems to be a very low consumer demand. Both Nanis et al.[8] and Brown[9] report that book

publishing only accounts for about 25% of the paper making industry, and that for some large companies paper for publishing accounts for less than five percent of their total output. Nanis and Brown also agree that if consumers demand for permanent paper increased paper producers would change much more quickly. Nanis feels that if the Government Printing Office, the largest publisher in the United States, were to demand alkaline paper we would all have the advantage of permanent paper.

Why is it so important to libraries to have alkaline paper? Recently, there has been a renewed concern that the world is losing an incredible amount of information. We are constantly losing information because books have become so embrittled that they crumble during use. There are three highly developed programs that will deacidify books, but they are extremely costly. One process costs approximately $1,000 per volume for labor and materials. Brown[10] reports that many libraries have increased their preservation budgets to be almost equal to their acquisitions budgets. One librarian was quoted as saying, "Just think of all the different books we could buy, if we didn't have to spend that money to save the books we have." [11] An important step towards saving today's materials well into the future is to publish on alkaline paper.

There have been important steps toward making all publishing on alkaline paper. In January, 1985 the American National Standards Institute developed a standard for alkaline, permanent paper. The

standard states that permanent paper must have a pH level of 7.5 or higher, at least a 2% alkaline reserve buffering agent, and no groundwood or unbleached pulp in the paper stock. The standard indicates that all publications that have enduring value should be printed on alkaline paper. This includes:

* important works of fiction and non-fiction;

* scholarly publications, monographs, and reprints;

* collected editions;

* encyclopedias, dictionaries, bibliographies, indexes, abstracts, and other reference works;

* publications intended primarily for the library market; and

* titles not appropriate for transfer to another format.[12]

This standard is only voluntary. The standard also issued a statement for materials that are printed on permanent paper. The statement is "This material meets Permanence of Paper for Printed Library Materials ANSI Z39:48-1984."[13] It is accompanied by the mathematical symbol for infinity, an eight (8) on its side. We begin to see that journals should clearly be printed on alkaline paper, according to the standard, because they are intended for library market. There are some serials, such as Time, which the publisher may view as primarily an end-user publication, rather than primarily for library market. These serials may or may not be considered to be covered by the valuable publications list, but still should

be published on alkaline paper. There is, however, a distinction that the scholarly publications are more likely to be printed on alkaline paper.

The need for alkaline paper in all library materials is clear, but most of the studies that libraries have performed have only tested monographs. Brown[14] when discussing the options for permanent retention of intellectual content reports that small libraries must rely on commercial microfilmers. He also states that for the Library of Congress, which subscribes to 75,000 magazines and about 1,500 newspapers, microfilming is a necessity. Even though serials should be included in the materials that are published on alkaline paper, it becomes apparent that there is an assumption that commercial microfilming is easily available, and minimizes that need.

After examining the need for all library materials to be printed on alkaline paper, several libraries have performed studies to determine how much of the collection is on alkaline paper and also the extent of embrittlement of the materials. Walker, Greenfield, Fox, and Simonoff[15] reported on a study that Yale University performed to determine the extent of deterioration of the collection. This study, considered to be one of the most thorough ever performed on this topic, has been used as a base line for other libraries as a comparison for their collections. Although this study was one of the largest, it did not address serials; it looked exclusively at monograph publications. Bond, DeCarlo, Henes, and

Snyder[16] reported on a similar study at Syracuse University Libraries. They studied pH level of the paper as well as embrittlement and other damage. The study included information about serials, which are included in the totals, and the statistics generated on the collection. A study performed by Butler[17] in 1990 examined the pH level of the paper of monographs acquired in 1987 at his library that were published by commercial American publishers. Butler examined the materials and divided them into groups by whether or not they had a statement on paper permanence. This study used a chlorophenol test to determine pH levels. They discovered that 67.5% of the books newly acquired from commercial American imprints were alkaline. They also discovered five books that were mislabeled as being permanent when in fact, they were acidic. The Butler study is the basis for this study, which will look at serial publications. It will be interesting to see if six years have made a difference in the accuracy of labeling on paper permanence, or on the availability of alkaline paper, and if serials are more likely to have acidic content than monographs.

III. METHODOLOGY

The hypotheses of this study are:

* that scholarly journals are more likely to be printed on permanent paper than non-scholarly journals;

* that European and United States publications are more likely to be alkaline than publications from other countries;

* that serials published in 1993 are more likely to be printed on alkaline paper than issues of the same serials published in 1988;

* that serials with paper permanence statements, in compliance with American National Standards Institute, have a very low incidence of acidic paper;

* and that serials are less likely to be alkaline than monographs.

In order to test the hypotheses, Spearman rank order correlation coefficient test is needed to determine the correlational level between the independent variables and the presence of alkaline or acidic paper. The population is all of the 1,063 serial publications that Ohio Wesleyan University is currently receiving. Ohio Wesleyan University was selected for convenience and accessibility, and the collection is assumed to be representative of small liberal arts colleges in the United States. In order to have a 95% confidence level plus or minus four percentage points

with expected responses being 35% and 65% for the binomial independent variable, a sample of 546 is needed. A random sample was selected using a random number table to select titles from an alphabetical list of titles currently being received. The list of titles included serials that were received on microfilm only, titles for which the paper copy was replaced by microfilm, and titles that the library kept for an academic year and then discarded. Seven other libraries were visited to locate paper issues that were not available at Ohio Wesleyan University. There were five titles that Ohio Wesleyan receives on microfilm only that could not be located at the other libraries visited and two titles that had delayed publication and no issues could be located. These seven titles were removed and seven new titles were selected continuing the same random number sequence from the alphabetical list of titles. No 1988 issues could be located for forty-one titles. In addition to the serials sampled, an equal sized random sample of monographs published in 1993 that the library has acquired was selected.

After selecting the sample, two issues from 1993 and two issues from 1988 were tested using a chlorophenol red pen. The color of the mark was tabulated. The chlorophenol pen will leave a yellow or clear mark on acidic paper and a purple mark on alkaline or neutral paper. Other information that was gathered on each serial included: whether or not it was peer reviewed, country of publication, type of publisher, and whether

or not the issue has a statement of paper permanence. The monographs were tested for pH level, and the country of origin and type publisher were noted; the presence of a statement of paper permanence was also noted. Spearman rank order correlation coefficient was performed to test the hypotheses that country of origin has a correlation to alkaline paper; that scholarly journals have a correlation to alkaline paper; and the date of publication has a correlation to alkaline paper. A frequency distribution was performed to support the hypotheses that very few serials with a statement of paper permanence will have acidic paper. A Spearman rank order correlation coefficient test was also performed to test the hypothesis that monographs and serials have different frequencies of alkaline paper.

IV. RESULTS

The titles included: forty-one titles for which no 1988 issues could be located; three titles for which only one 1993 issue could be located, and eleven titles that were annuals for which only one issue from 1993 and one from 1988 were available. The following table shows the number of titles that were in each category.

TABLE 1. Distribution of Publications Tested by Year and Type of Paper.

	1993-1	1993-2	1988-1	1988-2	BOOK
ALKALINE	442	414	281	277	488
ACIDIC	104	121	224	216	58
NOT FOUND/N.A.	0	11	41	53	0

The data collected from the sample were entered into Minitab, a commercially available statistical software package. To test the hypotheses, the values assigned for pH level for the two 1993 issues were added together and the two 1988 issues were added together.

TABLE 2. Distribution of Titles with Alkaline and Acidic Paper.

	2 ALKALINE	1 ALKALINE/1 ACIDIC	2 ACIDIC
1993	397	51	87
1988	245	56	193

For 1988, the number of titles missing issues was forty-one. There were

eleven titles that only one 1988 issue was located and all eleven were alkaline.

The hypothesis that scholarly journals are more likely to be printed on alkaline paper than non-scholarly journals needs to be tested using a null hypothesis, "There is no difference between scholarly and non-scholarly journals and alkaline paper use." When the sample was collected, the serials that were peer reviewed were distinguished from the serials that were not peer reviewed. A Spearman rho correlation coefficient test was performed, and a value of -0.165 was obtained. Using the formula $|t=r\sqrt{N-2/1-r^2}|$ where t=the t-value, r=the obtained correlation coefficient, and N=the number of observations, a t-value of 3.90 was obtained. The t-value was compared to a table. For a .05 significance level for a directional test having six degrees of freedom the critical value is 1.943. Because the t-value is greater than the table critical value the null hypothesis can be rejected. Therefore, there is an observed difference, and serials that are scholarly (peer reviewed) are more likely to be printed on alkaline paper than non-scholarly (not peer reviewed) serials. In addition to scholarly journals, location of publishing could also be correlated to alkaline paper use.

The null hypothesis, "There is no difference in alkaline paper use for serials published in the United States, Canada, and European countries and serials published in Asian, South American, and African countries," is also

tested. Table 3 indicates the frequencies of geographic location of the publisher.

TABLE 3. Distribution of Sample by Geographic Locations

	Serials	Books
U.S./Canada	468	502
Europe	72	38
South/Latin America	0	1
Asia	4	5
Africa	0	0

When the sample was tested, country of publication was noted. A Spearman rho correlation coefficient was performed and a value of -0.088 was obtained. The t-value formula, shown before, was again used to determine the t-value, which equals 2.030. The t-value was again compared to a table of critical values. The table value is less than the tested value, therefore the null hypothesis can be rejected. Serials published in the United States, Canada and European countries are more likely to be printed on alkaline paper than serials published in Asia, South and Latin America and Africa. This result, however, is questionable due to the very small number of titles that were not from the United States, Canada, or European Countries. A different study with a purposeful sample that includes a larger representation of other areas of the world may provide a much more interesting statistical picture.

The permanence of paper statement is believed to have a high

degree of validity. The number of serials titles that had statements of paper permanence was 115 and the number of monographs that had statements of paper permanence was 148. The fact that the actual number of titles that did have acid-free paper was so much higher than the number of titles that stated that they were acid free is interesting. Of the 546 serial titles tested, only two, or 0.366%, that had statements of paper permanence had issues that tested for acidic paper. Of the 546 monographs tested, there were four that had statements of paper permanence and tested for acidic paper. This represents 0.733% of the sample. Therefore, it is true that the statement of paper permanence does have a high degree of validity. However, simply because a publication does not have a statement of permanence, a conclusion that it is not alkaline is not valid.

To test that serials are less likely than monographs to be alkaline the null hypothesis, "There is no observable difference between serials and monograph publishing and alkaline paper use," is tested. The Spearman rho correlation coefficient is again run and a value of 0.029 is obtained. The formula is used to obtain a t-value, 0.6767. This is again compared to the table of critical values. The critical value for a .05 level of significance for a directional test with six degrees of freedom is 1.943. Because the table critical value is greater than the tested t-value the null hypothesis must be retained.

TABLE 4. Distribution of Alkaline/Acidic Paper use in 1993 Publications

	ALKALINE	ACIDIC
SERIALS (both issues)	397	87
BOOKS	488	58

Therefore, there is no observable difference between serial and monograph publications and the likelihood of alkaline paper use. This conclusion possibly represents that publishers of serials and publishers of monographs are frequently the same. Also, serials publishers and monograph publishers are using the same printing companies and the same paper manufacturers.

To test the hypothesis that serials published in 1993 are more likely to be on alkaline paper than serials published in 1988, the null hypothesis, "There is no difference between serials published in 1993 and 1988 and alkaline paper use," is tested. The Spearman test is run and an observed value of 0.358 is obtained. The t-value formula is used again and gives a value of 8.943. Comparing this value to the table of critical values, for a directional test with .05 level of significance and 8 degrees of freedom, the table value is 1.860. The tested value is much higher and the null hypothesis can be rejected. Serials published in 1993 are more likely to be published on alkaline paper than serials published in 1988. The two issues of the 546 titles tested in 1993 resulted in 856 issues testing alkaline, and in 1988 only 558 were alkaline. The t-value of this

hypothesis, having a value so close to one, indicates that there has been a statistically dramatic increase in the number of serials published that are printed on alkaline paper over the number of serials printed on alkaline paper five years ago.

V. CONCLUSIONS

This test has confirmed that serials that are peer reviewed, and published in the United States, Canada, and European countries are more likely to be printed on alkaline paper than serials that are not peer reviewed or those published in other countries. This study also confirmed that there has been a dramatic increase in the amount of serials published in 1993 that are printed on alkaline paper over the amount of serials published five years earlier. This increase is wonderful news for libraries, because the information found in serial publications is so important to retain as part of the body of knowledge. Publishing serials on alkaline paper is very important for enabling libraries to retain this information without added costs. Unfortunately, serials such as Time, that are not considered to be worth retaining by the publishers, are not as likely to be published on alkaline paper. Libraries need to keep the information available regarding these publications as well as the more scholarly journals. Libraries can use the information obtained in this study to help determine preservation and retention issues for their serials collections. The interesting area of this study is that monographs are not more likely to be published on alkaline paper than serials. This seems to indicate that publishers of serials are as likely to look for printers that use alkaline paper as monograph publishers are. While testing the hypotheses of this study, other areas for further study arose.

Recommendations for Future Study

The number of titles that have both an acidic and an alkaline issue

was fifty-one in 1993 and fifty-six in 1988. This is probably an accurate representation of the number of titles that use whatever type of paper happens to be available. However, there may be many titles that had an acidic issue in 1993, that was not one of the issues tested. This could be an interesting area for additional study. How many of the titles have both acidic and alkaline issues during a year? This is important because acidic issues bound together with alkaline issues may have a deteriorating affect on the alkaline issues. Also, while collecting data, it was noticed that serial titles that are general interest, library science, music, and other disciplines seemed to have a higher share of acidic issues than serials in the scientific disciplines. A study of serials and possibly monographs using the broad divisions of the Library of Congress classification system could provide interesting results. Finally, the type of publisher such as: association/society, university press, or commercial publisher may also be a factor in alkaline paper use. The type of publisher as well as country were noted in the course of this study and may be used in the future to determine if there is any correlation between type of publisher and alkaline paper usage in monograph as well as serials publications.

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